Refine Search

Search Results -

Terms	Documents
(arbiter or manager) same request same priority same ticket	6

Database:
US Pre-Grant Publication Full-Text Database
US Patents Full-Text Database
US OCR Full-Text Database
EPO Abstracts Database
JPO Abstracts Database
Derwent World Patents Index
IBM Technical Disclosure Bulletins

Search: L1

Refine Search

Recall Text | Clear | Interrupt

Search History

DATE: Tuesday, June 08, 2004 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
DB=USPT,USOC; PLUR=YES; OP=OR			
L1	(arbiter or manager) same request same priority same ticket	6	L1

END OF SEARCH HISTORY

h e b b cg b e e ch

Refine Search

Search Results -

Terms	Documents
L1	0

Database:

US Pre-Grant Publication Full-Text Database
US Patents Full-Text Database
US OCR Full-Text Database
EPO Abstracts Database
JPO Abstracts Database
Derwent World Patents Index
IBM Technical Disclosure Bulletins

Search: L2

Refine Search

Recall Text | Clear | Interrupt

Search History

DATE: Tuesday, June 08, 2004 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
DB=EPAB,JPAB,DWPI,TDBD; PLUR=YES; OP=OR			
L2	L1	0	L2
DB=USPT,USOC; PLUR=YES; OP=OR			
L1	(arbiter or manager) same request same priority same ticket	6	L1

END OF SEARCH HISTORY

h e b b cg b e e ch

Refine Search

Search Results -

Terms	Documents
L3 same assign$3	135

Database:
US Pre-Grant Publication Full-Text Database
US Patents Full-Text Database
US OCR Full-Text Database
EPO Abstracts Database
JPO Abstracts Database
Derwent World Patents Index
IBM Technical Disclosure Bulletins

Search: L5

Refine Search

Recall Text | Clear | Interrupt

Search History

DATE: Tuesday, June 08, 2004 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
DB=USPT,USOC; PLUR=YES; OP=OR			
L5	l3 same assign$3	135	L5
L4	(arbiter or manager) same request same priority same number	409	L4
L3	(arbiter or manager) same request same priority same (number or value)	529	L3
DB=EPAB,JPAB,DWPI,TDBD; PLUR=YES; OP=OR			
L2	L1	0	L2
DB=USPT,USOC; PLUR=YES; OP=OR			
L1	(arbiter or manager) same request same priority same ticket	6	L1

END OF SEARCH HISTORY

h e b b cg b e e ch

Refine Search

Search Results -

Terms	Documents
(arbiter or manager) same request same priority same (unique adj1 (number or value))	0

Database:
US Pre-Grant Publication Full-Text Database
US Patents Full-Text Database
US OCR Full-Text Database
EPO Abstracts Database
JPO Abstracts Database
Derwent World Patents Index
IBM Technical Disclosure Bulletins

Search: L8

Refine Search | Recall Text | Clear | Interrupt

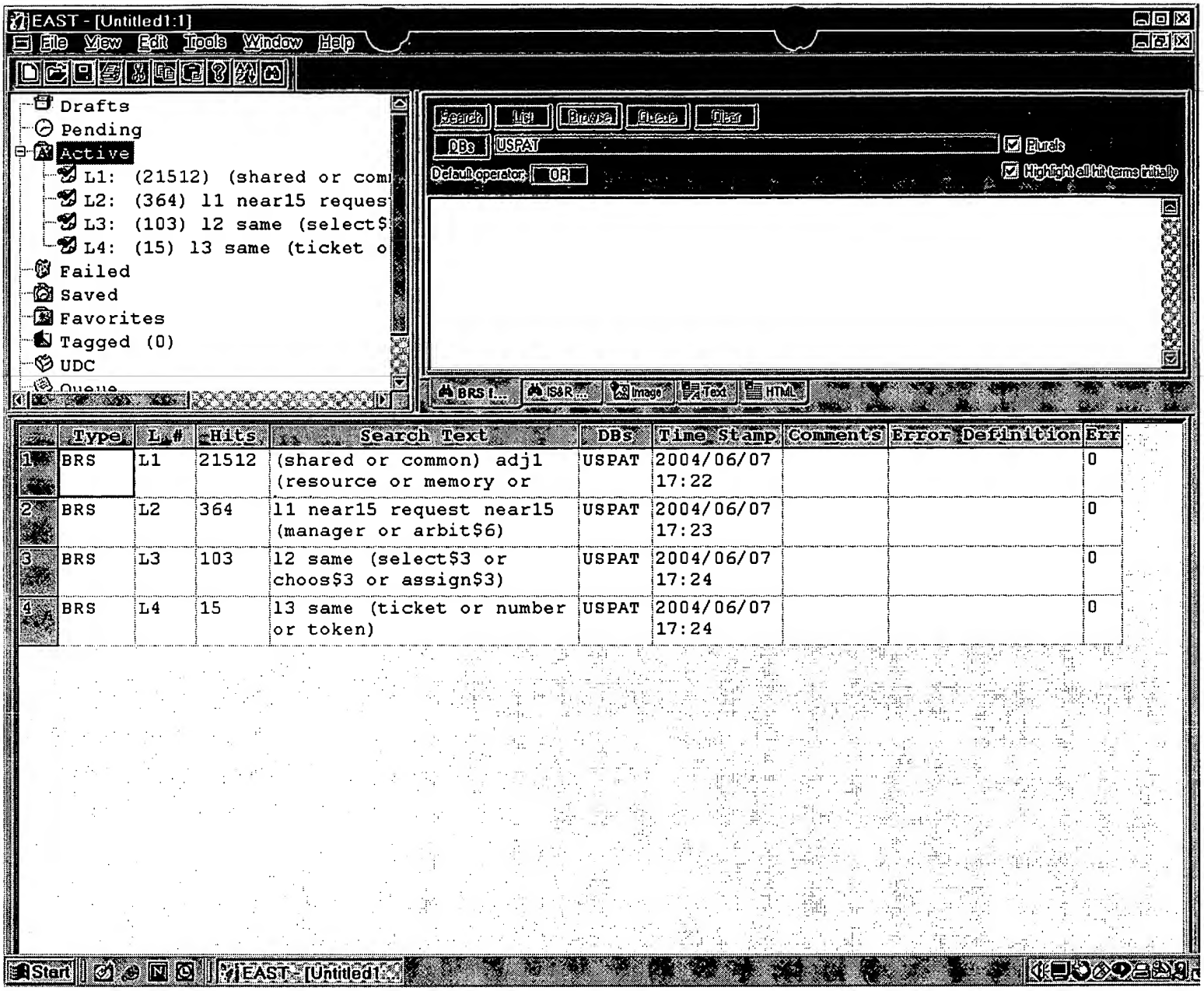
Search History

DATE: Tuesday, June 08, 2004 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
DB=USPT,USOC; PLUR=YES; OP=OR			
L8	(arbiter or manager) same request same priority same (unique adj1 (number or value))	0	L8
L7	l4.ab.	13	L7
L6	L5.ab.	4	L6
L5	l3 same assign$3	135	L5
L4	(arbiter or manager) same request same priority same number	409	L4
L3	(arbiter or manager) same request same priority same (number or value)	529	L3
DB=EPAB,JPAB,DWPI,TDBD; PLUR=YES; OP=OR			
L2	L1	0	L2
DB=USPT,USOC; PLUR=YES; OP=OR			
L1	(arbiter or manager) same request same priority same ticket	6	L1

END OF SEARCH HISTORY

h e b b cg b e e ch


EAST - [Untitled1:1]
File View Edit Tools Window Help
Drafts
Pending
Active
L1: (21512) (shared or com
L2: (364) l1 near15 reques
L3: (103) l2 same (select$
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Tagged (0)
UDC
Queue
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Browse
Fulcrum
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DBs
USPAT
Default operator:
OR
Fulcrum
Highlight all hit terms initially
BRS I...
IS&R...
Image
Text
HTML
Type
L #
Hits
Search Text
DBs
Time Stamp
Comments
Error Definition
Err
1 BRS L1 21512 (shared or common) adj1 (resource or memory or USPAT 2004/06/07 17:22 0
2 BRS L2 364 l1 near15 request near15 (manager or arbit$6) USPAT 2004/06/07 17:23 0
3 BRS L3 103 l2 same (select$3 or choos$3 or assign$3) USPAT 2004/06/07 17:24 0
4 BRS L4 15 l3 same (ticket or number or token) USPAT 2004/06/07 17:24 0
Start
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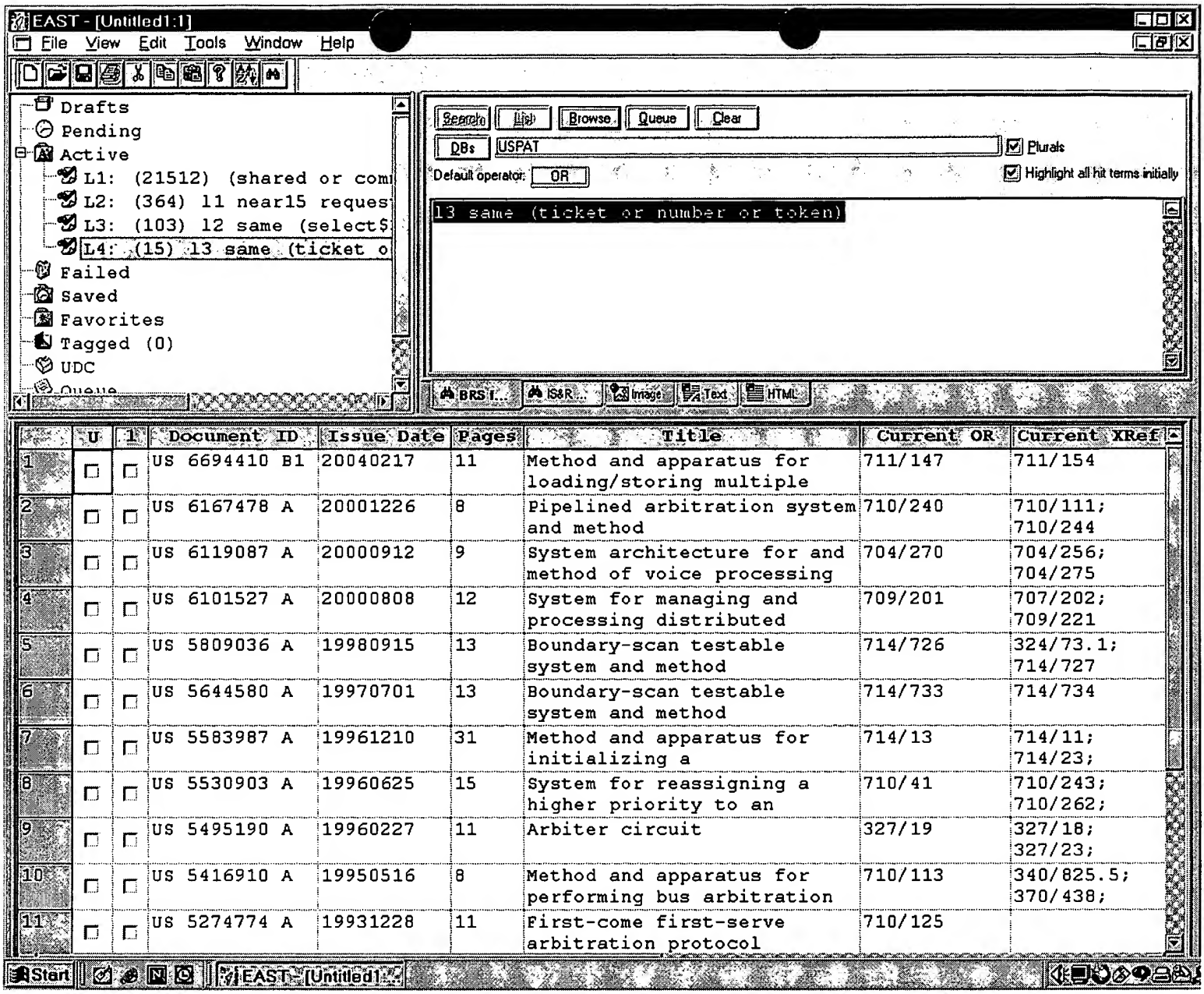

	U	1	Document ID	Issue Date	Pages	Title	Current OR	Current XRef
1	☐	☐	US 6694410 B1	20040217	11	Method and apparatus for loading/storing multiple	711/147	711/154
2	☐	☐	US 6167478 A	20001226	8	Pipelined arbitration system and method	710/240	710/111; 710/244
3	☐	☐	US 6119087 A	20000912	9	System architecture for and method of voice processing	704/270	704/256; 704/275
4	☐	☐	US 6101527 A	20000808	12	System for managing and processing distributed	709/201	707/202; 709/221
5	☐	☐	US 5809036 A	19980915	13	Boundary-scan testable system and method	714/726	324/73.1; 714/727
6	☐	☐	US 5644580 A	19970701	13	Boundary-scan testable system and method	714/733	714/734
7	☐	☐	US 5583987 A	19961210	31	Method and apparatus for initializing a	714/13	714/11; 714/23;
8	☐	☐	US 5530903 A	19960625	15	System for reassigning a higher priority to an	710/41	710/243; 710/262;
9	☐	☐	US 5495190 A	19960227	11	Arbiter circuit	327/19	327/18; 327/23;
10	☐	☐	US 5416910 A	19950516	8	Method and apparatus for performing bus arbitration	710/113	340/825.5; 370/438;
11	☐	☐	US 5274774 A	19931228	11	First-come first-serve arbitration protocol	710/125	

L6: Entry 2 of 10 File: USPT Dec 26, 2000

DOCUMENT-IDENTIFIER: US 6167478 A
TITLE: Pipelined arbitration system and method

CLAIMS:

10. In a system having multiple requestors requesting a shared resource, wherein each requestor is assigned a unique service request priority number, a method of arbitrating access to the shared resource, comprising the steps of:

generating a plurality of service request signals;

combining the service request signals in first and second OR-trees to produce an OR-ed result; each of said first and second OR-trees adapted to receive a plurality of service request signals;

performing an arbitration protocol on the OR-ed result to determine the requestor with the highest priority number; and

issuing an access request signal to the shared resource.

15. In a system having multiple requesters requesting a shared resource, wherein each requestor is assigned a unique service request priority number, a method of arbitrating access to the shared resource, comprising the steps of:

generating a plurality of service request signals,;

combining the service request signals in first and second OR-trees to produce an OR-ed result;

performing an arbitration protocol on the OR-ed result to determine the requestor with the highest priority number; and

issuing an access request signal to the shared resource;

wherein said unique service request priority number comprises a predetermined number of bits and further comprising the step of, for each service requester, selectively applying the bits of said service requestor's unique priority number to said first and second OR-trees;

wherein each service request comprises an ITREE AND-gate and an UTREE AND-gate, and wherein said generating step comprises:

applying the bits of said priority number to said ITREE gate and said UTREE gate; and

responsive to said count signal, selectively enabling the bits of said priority number to said ITREE and said UTREE.

First Hit Fwd Refs

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L6: Entry 2 of 10 File: USPT Dec 26, 2000

US-PAT-NO: 6167478
DOCUMENT-IDENTIFIER: US 6167478 A

TITLE: Pipelined arbitration system and method

DATE-ISSUED: December 26, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bacigalupo; Tommaso	San Jose	CA		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Infineon Technologies North America Corp.					02

APPL-NO: 09/ 167652 [PALM]
DATE FILED: October 5, 1998

INT-CL: [07] G06 F 12/00

US-CL-ISSUED: 710/240; 710/111, 710/244
US-CL-CURRENT: 710/240; 710/111, 710/244

FIELD-OF-SEARCH: 710/200, 710/240, 710/244, 710/111, 710/113, 710/114, 710/116, 710/118, 710/220, 710/241, 710/242, 710/243, 710/128, 710/126, 710/129, 710/125, 710/123, 710/121, 710/120

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	5101482	March 1992	Kipnis	710/118
☐	5303382	April 1994	Buch et al.	395/725
☐	5617575	April 1997	Sakakibara et al.	712/34
☐	5640585	June 1997	Smoot, III et al.	395/800
☐	5680594	October 1997	Charneski et al.	395/556
☐	5748969	May 1998	Lee et al.	710/113
☐	5931924	August 1999	Arimilli et al.	710/116

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☐ 5935234 August 1999 Arimilli et al. 710/116

ART-UNIT: 271

PRIMARY-EXAMINER: Auve; Glenn A.

ASSISTANT-EXAMINER: Chung-Trans; X.

ABSTRACT:

An access control system (10) for controlling access to a shared resource among a plurality of service requestors is described. When a service requestor seeks access to the shared resource, it generates a service request signal which includes its assigned unique service request priority number. The outputs of all the service requesters are applied to pipelined first and second OR-trees (75, 78) which produce an OR-ed output signal. The OR-ed output signal is then applied to an access control unit (38) which performs an arbitration protocol to determine the highest priority number. Each service requester includes a state machine which selectively applies the bits of its priority number to the OR-trees (75, 78). The use of pipelined protocol with two OR-trees (75, 78) reduces cycle consumption and permits arbitration within a single clock cycle.

20 Claims, 4 Drawing figures

L6: Entry 8 of 10 File: USPT Dec 28, 1993

DOCUMENT-IDENTIFIER: US 5274774 A
** See image for Certificate of Correction **
TITLE: First-come first-serve arbitration protocol

Brief Summary Text (11):
A third scheme, the parallel contention arbiter as described in the references cited above, is based on assigning each agent a unique fixed k-bit arbitration number called its "identity." The value of k is at least [log.sub.2 (N+1)], where N is the maximum number of agents that can be attached to the bus. An agent that wants control of the bus forces a wired-OR shared bus request line, and waits for a signal to start arbitration. The signal to start arbitration may be generated by the current bus master, a central timing controller, or any agent on the bus. At the start of an arbitration, the agent applies its arbitration number to a separate parallel set of arbitration control lines provided on the bus for this purpose. The agent then monitors each of the arbitration lines, in parallel. If the value carried by line i is "1," but the agent is applying a "0" to it, then the agent removes the lower-order (i-1 to 0) bits of its identity. If line i drops back to "0," the agent reapplies the lower-order bits it removed before. For example, consider the case where two agents with identities 1010101 and 0011100, respectively, are requesting the bus. The first agent will remove its three lowest order bits, leaving 1010000, and the second agent will remove all of its bits. Next, the first agent will reapply its three lowest order bits, and the second agent will do nothing, since the most significant bit still remains. It is easy to see that after some period of time the system reaches steady state, in which the lines carry the largest identity of all competing agents. The agent whose arbitration number matches the winning number becomes the next bus master. Note that at the end of the arbitration, each agent knows the identity of the winner, as well as whether it has won or lost. The parallel contention arbiter thus described is a priority arbiter that is very fast but is also inherently unfair, since an agent with a higher identity will always win an arbitration against an agent with a lower identity, and thus higher priority agents will disproportionately control the bus.

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L6: Entry 8 of 10 File: USPT Dec 28, 1993

US-PAT-NO: 5274774
DOCUMENT-IDENTIFIER: US 5274774 A
**** See image for Certificate of Correction ****

TITLE: First-come first-serve arbitration protocol

DATE-ISSUED: December 28, 1993

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Manber; Udi	Tucson	AZ		
Vernon; Mary K.	Madison	WI		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Wisconsin Alumni Research Foundation	Madison	WI			02

APPL-NO: 07/ 879059 [PALM]
DATE FILED: April 30, 1992

PARENT-CASE:
CROSS-REFERENCE TO RELATED APPLICATIONS This application is a continuation of U.S. Ser. No. 07/304,701 filed Jan. 31, 1989, now abandoned.

INT-CL: [05] G06F 13/00, G06F 13/362

US-CL-ISSUED: 395/325; 364/242.7, 364/242.8, 364/230.1, 364/282.4
US-CL-CURRENT: 710/125

FIELD-OF-SEARCH: 395/650, 395/700, 395/325

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	3629854	December 1971	Hauck	395/325
☐	3761879	September 1973	Brandsma et al.	395/325
☐	3813651	May 1974	Yamada	395/325
☐	4099233	July 1978	Barbagelata et al.	395/250

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☐	4257095	March 1981	Nadir	395/325
☐	4263649	April 1981	Lapp, Jr.	395/325
☐	4321669	March 1982	Macmillan	395/325
☐	4363094	December 1982	Kaul et al.	395/325
☐	4374413	February 1983	Comfort et al.	395/725
☐	4374414	February 1983	Comfort et al.	395/725
☐	4375639	March 1983	Johnson, Jr.	395/325
☐	4385350	May 1983	Hansen et al.	395/325
☐	4418386	November 1983	Vrielink	395/325
☐	4419724	December 1983	Branigin et al.	395/325
☐	4463445	July 1984	Grimes	395/325
☐	4488217	December 1984	Binder et al.	395/375
☐	4600988	July 1986	Tendulkar et al.	395/325
☐	4682282	July 1987	Beasley	395/775
☐	4920486	April 1990	Nielsen	395/325

OTHER PUBLICATIONS

Gustavson, David B., "Computer Buses--A Tutorial," IEE Micro, Aug. 1984.
Vernon and Manber, "Distributed Round-Robin and First-Come First-Serve Protocols and Their Application to Multiprocessor Bus Arbitration," Computer Sciences Technical Report #745, Feb. 1988.

ART-UNIT: 236

PRIMARY-EXAMINER: Shaw; Gareth D.

ASSISTANT-EXAMINER: Chavis; John Q.

ATTY-AGENT-FIRM: Quarles & Brady

ABSTRACT:

A first-come first-serve arbitration protocol arbitrates between processing agents seeking access to a common bus. The system is an extension of a parallel contention arbiter in which each agent has an identity value made up of two portions, one a fixed portion and one a variable portion. The variable portion of each agent's identity is incremented depending on how long the agent has been waiting for access to the bus and the variable portion is the most significant portion of each agent's identity. Thus in each arbitration in which the highest identity value is awarded control of the bus, the agent which has waited the longest will gain access to the bus prior to those which have not waited as long.

5 Claims, 3 Drawing figures

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L6: Entry 9 of 10 File: USPT Feb 11, 1992

DOCUMENT-IDENTIFIER: US 5088024 A
** See image for Certificate of Correction **
TITLE: Round-robin protocol method for arbitrating access to a shared bus arbitration providing preference to lower priority units after bus access by a higher priority unit

Brief Summary Text (11):
A third scheme, the parallel contention arbiter as described in the references cited above, is based on assigning each agent a unique fixed k-bit arbitration number called its "identity." The value of k is at least [log.sub.2 (N+1)], where N is the maximum number of agents that can be attached to the bus. An agent that wants control of the bus forces a wired-OR shared bus request line, and waits for a signal to start arbitration. The signal to start arbitration may be generated by the current bus master, a central timing controller, or any agent on the bus. At the start of an arbitration, the agent applies its arbitration number to a separate parallel set of arbitration control lines provided on the bus for this purpose. The agent then monitors each of the arbitration lines, in parallel. If the value carried by line i is "1," but the agent is applying a "0" to it, then the agent removes the lower-order (i-1 to 0) bits of its identity. If line i drops back to "0," the agent reapplies the lower-order bits it removed before. For example, consider the case where two agents with identities 1010101 and 0011100, respectively, are requesting the bus. The first agent will remove its three lowest order bits, leaving 1010000, and the second agent will remove all of its bits. Next, the first agent will reapply its three lowest order bits, and the second agent will do nothing, since the most significant bit still remains. It is easy to see that after some period of time the system reaches steady state, in which the lines carry the largest identity of all competing agents. The agent whose arbitration number matches the winning number becomes the next bus master. Note that at the end of the arbitration, each agent knows the identity of the winner, as well as whether it has won or lost. The parallel contention arbiter thus described is a priority arbiter that is very fast but is also inherently unfair, since an agent with a higher identity will always win an arbitration against an agent with a lower identity, and thus higher priority agents will disproportionately control the bus.

Detailed Description Text (4):
The first, and probably simplest embodiment of the round-robin protocol requires an extra bit of shared information, that is one extra bit on the parallel arbitration bus 20. This bit is called the round-robin bit. The round-robin bit is treated as the most significant bit of each agent's identity. Each agent records the identity of the winning agent, i.e. the agent that gained control of the bus, at the end of every arbitration, excluding the round-robin priority bit. Thus only the unique static portion of the identity for the winning station is recorded. An agent asserts the shared bus request line and competes in the next arbitration whenever it desires control of the bus. When an agent competes in an arbitration, the agent sets its round-robin bit for its identity to "one" if its static identity value is less than the recorded static identity value of the winner of the previous arbitration. The logic needed to implement this protocol primarily consists of a register in each agent to store the winning identity, and a comparator in each agent to determine if the agent's assigned arbitration number is less than the

recorded value. Alternatively, a comparator and one bit of storage for the result may be used. The output of the comparator is used as the round-robin bit of the agent's arbitration number. Note that this logic replaces the logic required to implement the assured access protocols of prior art parallel contention arbiters.

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L6: Entry 9 of 10 File: USPT Feb 11, 1992

US-PAT-NO: 5088024
DOCUMENT-IDENTIFIER: US 5088024 A
**** See image for Certificate of Correction ****

TITLE: Round-robin protocol method for arbitrating access to a shared bus arbitration providing preference to lower priority units after bus access by a higher priority unit

DATE-ISSUED: February 11, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Vernon; Mary K.	Madison	WI		
Manber; Udi	Tuscon	AZ		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Wisconsin Alumni Research Foundation	Madison	WI			02

APPL-NO: 07/ 304491 [PALM]
DATE FILED: January 31, 1989

INT-CL: [05] G06F 13/36

US-CL-ISSUED: 395/725; 364/240.1, 364/242.7, 364/242.92, 364/937.01, 364/DIG.1, 364/DIG.2
US-CL-CURRENT: 710/111

FIELD-OF-SEARCH: 364/2MSFile, 364/9MSFile, 340/825.5

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	497148	November 1890	Matteson	364/200
☐	3629854	December 1971	Hauck	364/200
☐	3761879	September 1973	Brandsma et al.	364/200
☐	3813651	May 1974	Yamada	364/200
☐	4009470	February 1977	Danilenko et al.	364/200

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☐	4099233	July 1978	Barbagelata et al.	364/200
☐	4232294	November 1980	Burke et al.	364/200
☐	4257095	March 1981	Nadir	364/200
☐	4263649	April 1981	Lapp, Jr.	364/200
☐	4321669	March 1982	Macmillan	364/200
☐	4363094	December 1982	Kaul et al.	364/200
☐	4374413	February 1983	Comfort et al.	364/200
☐	4374414	February 1983	Comfort et al.	364/200
☐	4375639	March 1983	Johnson, Jr.	340/825.5
☐	4385350	April 1983	Hansen et al.	364/200
☐	4418386	November 1983	Vrielink	364/200
☐	4419724	December 1983	Branigin et al.	364/200
☐	4463445	July 1984	Grimes	364/900
☐	4488217	December 1984	Binder et al.	364/200
☐	4554628	November 1985	Bell	364/200
☐	4600988	July 1986	Tendulkar et al.	364/200
☐	4620278	October 1986	Ellsworth et al.	364/200
☐	4809164	February 1989	Fuller	364/200
☐	4908749	March 1990	Marshall et al.	364/200
☐	4926419	May 1990	Whipple	370/85.6

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
2110847	February 1983	GB	

OTHER PUBLICATIONS

Gustavson, David B., "Computer Buses--A Tutorial", IEE Micro, Aug. 1984.
Vernon and Manber, "Distributed Round-Robin and First-Come First-Serve Protocols and Their Application to Multiprocessor Bus Arbitration", Computer Sciences Technical Report #745, Feb. 1988.

ART-UNIT: 232

PRIMARY-EXAMINER: Lee; Thomas C.

ASSISTANT-EXAMINER: Ellis; Richard Lee

ATTY-AGENT-FIRM: Quarles & Brady

ABSTRACT:

A protocol is disclosed for the round-robin distributed arbitration of access to a common resource, such as a bus, in a multiprocessor system or machine. The protocol

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assigns identity values to each agent, or processor, which are compared during each arbitration to determine which agent is awarded control of the bus. To enhance fairness agents having an identity value lower than the winner of the last arbitration are favored over agents having a higher identity value in the next subsequent arbitration.

5 Claims, 3 Drawing figures

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L6: Entry 9 of 10 File: USPT Feb 11, 1992

US-PAT-NO: 5088024
DOCUMENT-IDENTIFIER: US 5088024 A
**** See image for Certificate of Correction ****

TITLE: Round-robin protocol method for arbitrating access to a shared bus arbitration providing preference to lower priority units after bus access by a higher priority unit

DATE-ISSUED: February 11, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Vernon; Mary K.	Madison	WI		
Manber; Udi	Tuscon	AZ		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Wisconsin Alumni Research Foundation	Madison	WI			02

APPL-NO: 07/ 304491 [PALM]
DATE FILED: January 31, 1989

INT-CL: [05] G06F 13/36

US-CL-ISSUED: 395/725; 364/240.1, 364/242.7, 364/242.92, 364/937.01, 364/DIG.1, 364/DIG.2
US-CL-CURRENT: 710/111

FIELD-OF-SEARCH: 364/2MSFile, 364/9MSFile, 340/825.5

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	497148	November 1890	Matteson	364/200
☐	3629854	December 1971	Hauck	364/200
☐	3761879	September 1973	Brandsma et al.	364/200
☐	3813651	May 1974	Yamada	364/200
☐	4009470	February 1977	Danilenko et al.	364/200

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☐	4099233	July 1978	Barbagelata et al.	364/200
☐	4232294	November 1980	Burke et al.	364/200
☐	4257095	March 1981	Nadir	364/200
☐	4263649	April 1981	Lapp, Jr.	364/200
☐	4321669	March 1982	Macmillan	364/200
☐	4363094	December 1982	Kaul et al.	364/200
☐	4374413	February 1983	Comfort et al.	364/200
☐	4374414	February 1983	Comfort et al.	364/200
☐	4375639	March 1983	Johnson, Jr.	340/825.5
☐	4385350	April 1983	Hansen et al.	364/200
☐	4418386	November 1983	Vrielink	364/200
☐	4419724	December 1983	Branigin et al.	364/200
☐	4463445	July 1984	Grimes	364/900
☐	4488217	December 1984	Binder et al.	364/200
☐	4554628	November 1985	Bell	364/200
☐	4600988	July 1986	Tendulkar et al.	364/200
☐	4620278	October 1986	Ellsworth et al.	364/200
☐	4809164	February 1989	Fuller	364/200
☐	4908749	March 1990	Marshall et al.	364/200
☐	4926419	May 1990	Whipple	370/85.6

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
2110847	February 1983	GB	

OTHER PUBLICATIONS

Gustavson, David B., "Computer Buses--A Tutorial", IEE Micro, Aug. 1984.
Vernon and Manber, "Distributed Round-Robin and First-Come First-Serve Protocols and Their Application to Multiprocessor Bus Arbitration", Computer Sciences Technical Report #745, Feb. 1988.

ART-UNIT: 232

PRIMARY-EXAMINER: Lee; Thomas C.

ASSISTANT-EXAMINER: Ellis; Richard Lee

ATTY-AGENT-FIRM: Quarles & Brady

ABSTRACT:

A protocol is disclosed for the round-robin distributed arbitration of access to a common resource, such as a bus, in a multiprocessor system or machine. The protocol

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assigns identity values to each agent, or processor, which are compared during each arbitration to determine which agent is awarded control of the bus. To enhance fairness agents having an identity value lower than the winner of the last arbitration are favored over agents having a higher identity value in the next subsequent arbitration.

5 Claims, 3 Drawing figures

L8: Entry 5 of 21 File: USPT Dec 26, 2000

DOCUMENT-IDENTIFIER: US 6167478 A
TITLE: Pipelined arbitration system and method

Abstract Text (1):
An access control system (10) for controlling access to a shared resource among a plurality of service requestors is described. When a service requestor seeks access to the shared resource, it generates a service request signal which includes its assigned unique service request priority number. The outputs of all the service requesters are applied to pipelined first and second OR-trees (75, 78) which produce an OR-ed output signal. The OR-ed output signal is then applied to an access control unit (38) which performs an arbitration protocol to determine the highest priority number. Each service requester includes a state machine which selectively applies the bits of its priority number to the OR-trees (75, 78). The use of pipelined protocol with two OR-trees (75, 78) reduces cycle consumption and permits arbitration within a single clock cycle.

CLAIMS:

10. In a system having multiple requestors requesting a shared resource, wherein each requestor is assigned a unique service request priority number, a method of arbitrating access to the shared resource, comprising the steps of:

generating a plurality of service request signals;

combining the service request signals in first and second OR-trees to produce an OR-ed result; each of said first and second OR-trees adapted to receive a plurality of service request signals;

performing an arbitration protocol on the OR-ed result to determine the requestor with the highest priority number; and

issuing an access request signal to the shared resource.

15. In a system having multiple requesters requesting a shared resource, wherein each requestor is assigned a unique service request priority number, a method of arbitrating access to the shared resource, comprising the steps of:

generating a plurality of service request signals,;

combining the service request signals in first and second OR-trees to produce an OR-ed result;

performing an arbitration protocol on the OR-ed result to determine the requestor with the highest priority number; and

issuing an access request signal to the shared resource;

wherein said unique service request priority number comprises a predetermined number of bits and further comprising the step of, for each service requester, selectively applying the bits of said service requestor's unique priority number to

said first and second OR-trees;

wherein each service request comprises an ITREE AND-gate and an UTREE AND-gate, and wherein said generating step comprises:

applying the bits of said priority number to said ITREE gate and said UTREE gate; and

responsive to said count signal, selectively enabling the bits of said priority number to said ITREE and said UTREE.

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☐ Generate Collection Print

L8: Entry 5 of 21 File: USPT Dec 26, 2000

US-PAT-NO: 6167478
DOCUMENT-IDENTIFIER: US 6167478 A

TITLE: Pipelined arbitration system and method

DATE-ISSUED: December 26, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bacigalupo; Tommaso	San Jose	CA		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Infineon Technologies North America Corp.					02

APPL-NO: 09/ 167652 [PALM]
DATE FILED: October 5, 1998

INT-CL: [07] G06 F 12/00

US-CL-ISSUED: 710/240; 710/111, 710/244
US-CL-CURRENT: 710/240; 710/111, 710/244

FIELD-OF-SEARCH: 710/200, 710/240, 710/244, 710/111, 710/113, 710/114, 710/116, 710/118, 710/220, 710/241, 710/242, 710/243, 710/128, 710/126, 710/129, 710/125, 710/123, 710/121, 710/120

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	5101482	March 1992	Kipnis	710/118
☐	5303382	April 1994	Buch et al.	395/725
☐	5617575	April 1997	Sakakibara et al.	712/34
☐	5640585	June 1997	Smoot, III et al.	395/800
☐	5680594	October 1997	Charneski et al.	395/556
☐	5748969	May 1998	Lee et al.	710/113
☐	5931924	August 1999	Arimilli et al.	710/116

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☐ 5935234 August 1999 Arimilli et al. 710/116

ART-UNIT: 271

PRIMARY-EXAMINER: Auve; Glenn A.

ASSISTANT-EXAMINER: Chung-Trans; X.

ABSTRACT:

An access control system (10) for controlling access to a shared resource among a plurality of service requestors is described. When a service requestor seeks access to the shared resource, it generates a service request signal which includes its assigned unique service request priority number. The outputs of all the service requesters are applied to pipelined first and second OR-trees (75, 78) which produce an OR-ed output signal. The OR-ed output signal is then applied to an access control unit (38) which performs an arbitration protocol to determine the highest priority number. Each service requester includes a state machine which selectively applies the bits of its priority number to the OR-trees (75, 78). The use of pipelined protocol with two OR-trees (75, 78) reduces cycle consumption and permits arbitration within a single clock cycle.

20 Claims, 4 Drawing figures

L8: Entry 20 of 21 File: USPT Jun 9, 1987

DOCUMENT-IDENTIFIER: US 4672536 A
TITLE: Arbitration method and device for allocating a shared resource in a data processing system

Abstract Text (1):
An arbitration method and device for a data processing system wherein N units share a common resource, to allocate the shared resource to a given unit selected from a number of units requesting access thereto.

Abstract Text (2):
An age value is assigned to each unit and corresponds to the age of the request that will be made by the unit. During an arbitration cycle, a unit whose request will be serviced, if the shared resource becomes available, is selected, this unit being the one whose request has an age value corresponding to the oldest request. Then, the age value associated with each unit is updated when the resource is available, the age of the selected unit assuming a value corresponding to that of the most recent request, the ages of the units not selected that correspond to requests more recent than the one made by the selected unit being increased by a given quantity, and the ages of the units not selected that correspond to requests older than the one made by the selected unit remaining unchanged.

CLAIMS:

1. An arbitration method for a data processing system wherein N units share a common resource, for allocating said resource to a selected unit, a request for access to said resource being made by each unit that desires to gain access thereto, and wherein a priority level is assigned to the requests and only those requests having the highest priority level being considered for selection, said method being characterized in that it includes the steps of:

assigning an initial age value to each unit, each age value corresponding to the age of the request that will be made by the unit, and each age value being encoded by means of group and rank values,

selecting during an arbitration cycle a unit whose request will be serviced if the shared resource is available, the selected unit being the one whose group and rank values correspond to the oldest request, and

updating the age value associated with each unit when a request has been selected and the resource is available, with the age of the selected unit assuming a value corresponding to that of the most recent request, the ages of the units not selected that correspond to requests more recent than the one made by the selected unit being increased by a given quantity, and the ages of the units not selected that correspond to requests older than the one made by the selected unit remaining unchanged.

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L8: Entry 20 of 21 File: USPT Jun 9, 1987

US-PAT-NO: 4672536
DOCUMENT-IDENTIFIER: US 4672536 A

TITLE: Arbitration method and device for allocating a shared resource in a data processing system

DATE-ISSUED: June 9, 1987

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Giroir; Didier	Antibes			FR
Lacoste; Gerard	Nice			FR

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
International Business Machines Corporation	Armonk	NY			02

APPL-NO: 06/ 593208 [PALM]
DATE FILED: March 26, 1984

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
EP	83430012.1	March 29, 1983

INT-CL: [04] G06F 9/00

US-CL-ISSUED: 364/200
US-CL-CURRENT: 710/241

FIELD-OF-SEARCH: 364/200, 364/900

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	3334191	August 1967	Arseneau	179/27
☐	4096571	June 1978	van der Mey	364/200
☐	4409656	October 1983	Andersen et al.	364/200

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☐	4417303	November 1983	Korowitz et al.	364/200
☐	4453214	June 1984	Adcock	364/200
☐	4484273	November 1984	Stiffler et al.	364/200
☐	4488218	December 1984	Grimes	364/200
☐	4499538	February 1985	Finger et al.	364/200

ART-UNIT: 237

PRIMARY-EXAMINER: Heckler; Thomas M.

ASSISTANT-EXAMINER: Mills; John G.

ATTY-AGENT-FIRM: Cooper; D. Kendall

ABSTRACT:

An arbitration method and device for a data processing system wherein N units share a common resource, to allocate the shared resource to a given unit selected from a number of units requesting access thereto.

An age value is assigned to each unit and corresponds to the age of the request that will be made by the unit. During an arbitration cycle, a unit whose request will be serviced, if the shared resource becomes available, is selected, this unit being the one whose request has an age value corresponding to the oldest request. Then, the age value associated with each unit is updated when the resource is available, the age of the selected unit assuming a value corresponding to that of the most recent request, the ages of the units not selected that correspond to requests more recent than the one made by the selected unit being increased by a given quantity, and the ages of the units not selected that correspond to requests older than the one made by the selected unit remaining unchanged.

2 Claims, 14 Drawing figures

US-PAT-NO: 6167478

DOCUMENT-IDENTIFIER: US 6167478 A

TITLE: Pipelined arbitration system and method

---------- KWIC ---------

Claims Text - CLTX (23):
10. In a system having multiple requestors requesting a shared resource, wherein each requestor is assigned a unique service request priority number, a method of arbitrating access to the shared resource, comprising the steps of:

Claims Text - CLTX (32):
15. In a system having multiple requesters requesting a shared resource, wherein each requestor is assigned a unique service request priority number, a method of arbitrating access to the shared resource, comprising the steps of:

US-PAT-NO: 5274774

DOCUMENT-IDENTIFIER: US 5274774 A
See image for Certificate of Correction

TITLE: First-come first-serve arbitration protocol

---------- KWIC ---------

Brief Summary Text - BSTX (11):

A third scheme, the parallel contention arbiter as described in the references cited above, is based on assigning each agent a unique fixed k-bit arbitration number called its "identity." The value of k is at least [log.sub.2 (N+1)], where N is the maximum number of agents that can be attached to the bus. An agent that wants control of the bus forces a wired-OR shared bus request line, and waits for a signal to start arbitration. The signal to start arbitration may be generated by the current bus master, a central timing controller, or any agent on the bus. At the start of an arbitration, the agent applies its arbitration number to a separate parallel set of arbitration control lines provided on the bus for this purpose. The agent then monitors each of the arbitration lines, in parallel. If the value carried by line i is "1," but the agent is applying a "0" to it, then the agent removes the lower-order (i-1 to 0) bits of its identity. If line i drops back to "0," the agent reapplies the lower-order bits it removed before. For example, consider the case where two agents with identities 1010101 and 0011100, respectively, are requesting the bus. The first agent will remove its three lowest order bits, leaving 1010000, and the second agent will remove all of its bits. Next, the first agent will reapply its three lowest order bits, and the second agent will do nothing, since the most significant bit still remains. It is easy to see that after some period of time the system reaches steady state, in which the lines carry the largest identity of all competing agents. The agent whose arbitration number matches the winning number becomes the next bus master. Note that at the end of the arbitration, each agent knows the identity of the winner, as well as whether it has won or lost. The parallel contention arbiter thus described is a priority arbiter that is very fast but is also inherently unfair, since an agent with a higher identity will always win an arbitration against an agent with a lower identity, and thus higher priority agents will disproportionately control the bus.

US-PAT-NO: 5088024

DOCUMENT-IDENTIFIER: US 5088024 A
See image for Certificate of Correction

TITLE: Round-robin protocol method for arbitrating access to a shared bus arbitration providing preference to lower priority units after bus access by a higher priority unit

---------- KWIC ---------

Brief Summary Text - BSTX (11):

A third scheme, the parallel contention arbiter as described in the references cited above, is based on assigning each agent a unique fixed k-bit arbitration number called its "identity." The value of k is at least [log.sub.2 (N+1)], where N is the maximum number of agents that can be attached to the bus. An agent that wants control of the bus forces a wired-OR shared bus request line, and waits for a signal to start arbitration. The signal to start arbitration may be generated by the current bus master, a central timing controller, or any agent on the bus. At the start of an arbitration, the agent applies its arbitration number to a separate parallel set of arbitration control lines provided on the bus for this purpose. The agent then monitors each of the arbitration lines, in parallel. If the value carried by line i is "1," but the agent is applying a "0" to it, then the agent removes the lower-order (i-1 to 0) bits of its identity. If line i drops back to "0," the agent reapplies the lower-order bits it removed before. For example, consider the case where two agents with identities 1010101 and 0011100, respectively, are requesting the bus. The first agent will remove its three lowest order bits, leaving 1010000, and the second agent will remove all of its bits. Next, the first agent will reapply its three lowest order bits, and the second agent will do nothing, since the most significant bit still remains. It is easy to see that after some period of time the system reaches steady state, in which the lines carry the largest identity of all competing agents. The agent whose arbitration number matches the winning number becomes the next bus master. Note that at the end of the arbitration, each agent knows the identity of the winner, as well as whether it has won or lost. The parallel contention arbiter thus described is a priority arbiter that is very fast but is also inherently unfair, since an agent with a higher identity will always win an arbitration against an agent with a lower identity, and thus higher priority agents will

L12: Entry 199 of 204 File: USPT Mar 29, 1988

DOCUMENT-IDENTIFIER: US 4734909 A
TITLE: Versatile interconnection bus

Brief Summary Text (283):
A third class of objects of the present invention is to provide a bused digital communication scheme and apparatus versatilely configurable in data widths, arbitration schemes, addressing and commanding schemes, transaction overlap (pipelining) or pin multiplexing, and latencies' format as besuit the intercommunication requirements of those user devices being interconnected. In this manner the single, replicatable, logical structure of the preferred embodiment of the present invention may be easily configured, via the insertion of eight parameters into registers, in order that disparate user chips of disparate purposes, disparate operational function, and disparate capabilities may be communicably interconnected in consideration of the user chip types and the system function served.

Detailed Description Text (221):
The largest impact of the Versatile Bus design rule in terms of chip complexity is probably the need to provide for assembly and disassembly of words of information whenever the Versatile Bus configuration uses fewer lines than exist on the chip. There are also differences in timing caused by configuration changes that may have subtle effects on chip operation if they are not accounted for properly. The preferred embodiment Versatile Bus Interface Logics chip design to be described supports all subsets of the 55255355 Versatile Bus configuration envelope, limited only by the rules for permitted Arbitration configuration parameters as shown in FIG. 20, the rule that the Data Lines parameter should be less than or equal to the data bits parameter, and some rules concerning allowable pin-multiplexed and pipelined configurations.

L1: Entry 57 of 128 File: USPT Jan 19, 1999

DOCUMENT-IDENTIFIER: US 5862356 A
TITLE: Pipelined distributed bus arbitration system

Abstract Text (1):
The present invention provides a scalable, modular and pipelined distributed bus arbitration system for efficiently resolving bus contention between sub-systems, e.g., processors, coupled to a common system bus. The arbitration system includes a plurality of distributed bus arbiters which receives the bus requests from the sub-systems and independently determine the next bus master. The arbitration protocol enables the arbitration process to be eliminated from the critical timing path thereby allowing the system to operate at the maximum system clock frequency possible for a given integrated circuit (IC) technology to reduce overall system clock latencies. Any change among the sub-systems during an arbitration clock cycle is based on any system bus request(s) which are active during a clock cycle immediately preceding the arbitration clock cycle, and is independent of any system bus request(s) asserted during the arbitration clock cycle. In addition, the arbitration protocol treats a current bus master, i.e., the bus master driving the system bus, preferentially. Each arbitration task is completed within a system clock cycle regardless of processor speed. As a result, the arbitration latency for retaining the current bus master is one system clock cycle while the latency for selecting and switching bus masters is two system clock cycles. In this implementation, a last port driver is the only sub-system permitted to assert a bus request in a clock cycle and immediately drive the system bus in the next immediate clock cycle. Conversely, when a second sub-system which is not the last port driver needs to drive an inactive system bus, the second sub-system asserts its bus request line in a first clock cycle, and arbitration occurs within all the respective bus arbiters occurs in a second clock cycle.

L5: Entry 118 of 135 File: USPT Feb 11, 1992

DOCUMENT-IDENTIFIER: US 5088024 A
**** See image for Certificate of Correction ****
TITLE: Round-robin protocol method for arbitrating access to a shared bus arbitration providing preference to lower priority units after bus access by a higher priority unit

Brief Summary Text (11):
A third scheme, the parallel contention arbiter as described in the references cited above, is based on assigning each agent a unique fixed k-bit arbitration number called its "identity." The value of k is at least [log.sub.2 (N+1)], where N is the maximum number of agents that can be attached to the bus. An agent that wants control of the bus forces a wired-OR shared bus request line, and waits for a signal to start arbitration. The signal to start arbitration may be generated by the current bus master, a central timing controller, or any agent on the bus. At the start of an arbitration, the agent applies its arbitration number to a separate parallel set of arbitration control lines provided on the bus for this purpose. The agent then monitors each of the arbitration lines, in parallel. If the value carried by line i is "1," but the agent is applying a "0" to it, then the agent removes the lower-order (i-1 to 0) bits of its identity. If line i drops back to "0," the agent reapplies the lower-order bits it removed before. For example, consider the case where two agents with identities 1010101 and 0011100, respectively, are requesting the bus. The first agent will remove its three lowest order bits, leaving 1010000, and the second agent will remove all of its bits. Next, the first agent will reapply its three lowest order bits, and the second agent will do nothing, since the most significant bit still remains. It is easy to see that after some period of time the system reaches steady state, in which the lines carry the largest identity of all competing agents. The agent whose arbitration number matches the winning number becomes the next bus master. Note that at the end of the arbitration, each agent knows the identity of the winner, as well as whether it has won or lost. The parallel contention arbiter thus described is a priority arbiter that is very fast but is also inherently unfair, since an agent with a higher identity will always win an arbitration against an agent with a lower identity, and thus higher priority agents will disproportionately control the bus.

Detailed Description Text (2):
The arbitration protocol of the present invention may be characterized as a distributed round-robin protocol that is an extension or improvement of priority arbiters such as the parallel contention arbiter described above. As in a parallel contention arbitration scheme, there are a series of agents 12 competing for a resource such as a bus 14. A shared wired-OR bus request line 16 is connected to each agent 12 as well as control lines 18 for starting an arbitration. A parallel arbitration bus 20 of k.gtoreq.[log.sub.2 (N+1)] is required for N agents, and the agents 12 are also connected in wired-OR logic to the arbitration bus 20. This arbitration protocol makes use of fixed assigned identity values for each agent. The initial arbitration is similar to the parallel contention arbiter described above. After one arbitration, however, the present protocol proceeds somewhat differently. If the first arbitration is won by agent with identity j, then in the next arbitration all agents with assigned identity values less than j, i.e. 1 through j-1, will be given priority over all agents having assigned identity values

greater than or equal to, i.e. j. through N. This protocol is based on a finding that if the fixed priority protocol is altered to permit the granting of special status, for one arbitration, of agents which have lower assigned values than the winner of the prior arbitration, then the overall distribution of bus access among the agents becomes perfectly fair.

Detailed Description Text (4):
The first, and probably simplest embodiment of the round-robin protocol requires an extra bit of shared information, that is one extra bit on the parallel arbitration bus 20. This bit is called the round-robin bit. The round-robin bit is treated as the most significant bit of each agent's identity. Each agent records the identity of the winning agent, i.e. the agent that gained control of the bus, at the end of every arbitration, excluding the round-robin priority bit. Thus only the unique static portion of the identity for the winning station is recorded. An agent asserts the shared bus request line and competes in the next arbitration whenever it desires control of the bus. When an agent competes in an arbitration, the agent sets its round-robin bit for its identity to "one" if its static identity value is less than the recorded static identity value of the winner of the previous arbitration. The logic needed to implement this protocol primarily consists of a register in each agent to store the winning identity, and a comparator in each agent to determine if the agent's assigned arbitration number is less than the recorded value. Alternatively, a comparator and one bit of storage for the result may be used. The output of the comparator is used as the round-robin bit of the agent's arbitration number. Note that this logic replaces the logic required to implement the assured access protocols of prior art parallel contention arbiters.

L5: Entry 118 of 135 File: USPT Feb 11, 1992

US-PAT-NO: 5088024
DOCUMENT-IDENTIFIER: US 5088024 A
**** See image for Certificate of Correction ****

TITLE: Round-robin protocol method for arbitrating access to a shared bus arbitration providing preference to lower priority units after bus access by a higher priority unit

DATE-ISSUED: February 11, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Vernon; Mary K.	Madison	WI		
Manber; Udi	Tuscon	AZ		

US-CL-CURRENT: 710/111

ABSTRACT:

A protocol is disclosed for the round-robin distributed arbitration of access to a common resource, such as a bus, in a multiprocessor system or machine. The protocol assigns identity values to each agent, or processor, which are compared during each arbitration to determine which agent is awarded control of the bus. To enhance fairness agents having an identity value lower than the winner of the last arbitration are favored over agents having a higher identity value in the next subsequent arbitration.

5 Claims, 3 Drawing figures
Exemplary Claim Number: 1
Number of Drawing Sheets: 3

L5: Entry 117 of 135 File: USPT Mar 17, 1992

DOCUMENT-IDENTIFIER: US 5097483 A
** See image for Certificate of Correction **
TITLE: Tri-statable bus with apparatus to drive bus line to first level and then second level for predetermined time before turning off

Detailed Description Text (5):
The present invention also comprises a controller/arbiter 14 which is coupled to the bus 10. As will be described more fully below, the controller 14 performs various functions including controlling and allocating access to the bus 10 among the various agents. The controller does this by asserting a bus grant signal over the bus grant line 49. Each agent coupled to the bus has a unique bus request, bus select and bus grant lines coupled between the controller/arbiter 14 and the particular agent. When an agent requires control of the bus, it asserts a signal over its bus request line 49. The controller 14 receives all such requests, prioritizes and stores them, waits until the bus is idle and asserts a bus grant signal over the bus grant line 49 to one of the requesting devices. In the preferred embodiment, the controller uses a round robin priority arbitration scheme. It will be apparent to these skilled in the art, however, that different arbitration schemes can be used as a matter of design choice. For example, the controller 14 could assign bus grants on a first-requested, first-granted basis. Alternatively, each agent could be assigned a unique priority number and the controller 14 could assign bus grants to the requesting agent with the highest priority. The controller also prevents the occurrence of deadlock conditions which arise when two or more agents seek access to the bus 10 at the same time. This accomplished through the use of a "rerun" protocol which is described below.

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L5: Entry 117 of 135 File: USPT Mar 17, 1992

DOCUMENT-IDENTIFIER: US 5097483 A

** See image for Certificate of Correction **

TITLE: Tri-statable bus with apparatus to drive bus line to first level and then second level for predetermined time before turning off

Detailed Description Text (5):

The present invention also comprises a controller/arbiter 14 which is coupled to the bus 10. As will be described more fully below, the controller 14 performs various functions including controlling and allocating access to the bus 10 among the various agents. The controller does this by asserting a bus grant signal over the bus grant line 49. Each agent coupled to the bus has a unique bus request, bus select and bus grant lines coupled between the controller/arbiter 14 and the particular agent. When an agent requires control of the bus, it asserts a signal over its bus request line 49. The controller 14 receives all such requests, prioritizes and stores them, waits until the bus is idle and asserts a bus grant signal over the bus grant line 49 to one of the requesting devices. In the preferred embodiment, the controller uses a round robin priority arbitration scheme. It will be apparent to these skilled in the art, however, that different arbitration schemes can be used as a matter of design choice. For example, the controller 14 could assign bus grants on a first-requested, first-granted basis. Alternatively, each agent could be assigned a unique priority number and the controller 14 could assign bus grants to the requesting agent with the highest priority. The controller also prevents the occurrence of deadlock conditions which arise when two or more agents seek access to the bus 10 at the same time. This accomplished through the use of a "rerun" protocol which is described below.

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L5: Entry 117 of 135 File: USPT Mar 17, 1992

US-PAT-NO: 5097483
DOCUMENT-IDENTIFIER: US 5097483 A
** See image for Certificate of Correction **

TITLE: Tri-statable bus with apparatus to drive bus line to first level and then second level for predetermined time before turning off

DATE-ISSUED: March 17, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bechtolsheim; Andreas	Stanford	CA		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Sun Microsystems, Inc.	Mountain View	CA			02

APPL-NO: 07/ 387227 [PALM]
DATE FILED: July 28, 1989

PARENT-CASE:
This is a divisional of application Ser. No. 07/313,250, filed Feb. 21, 1989.

INT-CL: [05] G06F 13/00, G06F 13/14, G06F 13/40, G06F 13/42

US-CL-ISSUED: 375/17; 375/36, 375/20, 364/942.51, 364/942.06, 364/953.3, 364/961.2, 364/927.93, 364/940, 364/940.8, 364/941.2, 364/DIG.2, 395/800
US-CL-CURRENT: 375/293; 375/257

FIELD-OF-SEARCH: 364/2MSFile, 364/9MSFile, 375/17, 375/20, 375/36

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	3938094	February 1976	Caudel	364/200
☐	4550368	October 1985	Bechtolsheim	364/200
☐	4595923	June 1986	McFarland, Jr.	333/130
☐	4630196	December 1986	Bednar, Jr. et al.	364/200
☐	4803621	February 1989	Kelly	364/200

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☐	4859877	August 1989	Cooperman et al.	207/443
☐	4945264	July 1990	Lee et al.	307/443

OTHER PUBLICATIONS

John Uffenbeck, Microcomputers and Microprocessors: The 8080, 8085 and Z-80 Programming, Interfacing, and Troubleshooting, Prentice-Hall, 1985.

ART-UNIT: 232

PRIMARY-EXAMINER: Lee; Thomas C.

ASSISTANT-EXAMINER: Geckil; Mehmet

ATTY-AGENT-FIRM: Blakely, Sokoloff, Taylor & Zafman

ABSTRACT:

An improved high speed data transfer bus with virtual memory capability is disclosed. The bus has particular applications in computer systems which employ peripheral devices. The bus allows high speed data transfer through the use of a virtual memory scheme. Moreover, the present invention minimizes the number of lines required to implement the bus. The present invention also minimizes the amount of time a particular device is required to wait before it can access the bus and complete a data transfer. Moreover, the present invention employs control signals that are driven both active and inactive, facilitating interfacing the bus to low-power CMOS technology.

14 Claims, 13 Drawing figures

L5: Entry 109 of 135 File: USPT Dec 28, 1993

DOCUMENT-IDENTIFIER: US 5274774 A
** See image for Certificate of Correction **
TITLE: First-come first-serve arbitration protocol

Brief Summary Text (11):
A third scheme, the parallel contention arbiter as described in the references cited above, is based on assigning each agent a unique fixed k-bit arbitration number called its "identity." The value of k is at least [log.sub.2 (N+1)], where N is the maximum number of agents that can be attached to the bus. An agent that wants control of the bus forces a wired-OR shared bus request line, and waits for a signal to start arbitration. The signal to start arbitration may be generated by the current bus master, a central timing controller, or any agent on the bus. At the start of an arbitration, the agent applies its arbitration number to a separate parallel set of arbitration control lines provided on the bus for this purpose. The agent then monitors each of the arbitration lines, in parallel. If the value carried by line i is "1," but the agent is applying a "0" to it, then the agent removes the lower-order (i-1 to 0) bits of its identity. If line i drops back to "0," the agent reapplies the lower-order bits it removed before. For example, consider the case where two agents with identities 1010101 and 0011100, respectively, are requesting the bus. The first agent will remove its three lowest order bits, leaving 1010000, and the second agent will remove all of its bits. Next, the first agent will reapply its three lowest order bits, and the second agent will do nothing, since the most significant bit still remains. It is easy to see that after some period of time the system reaches steady state, in which the lines carry the largest identity of all competing agents. The agent whose arbitration number matches the winning number becomes the next bus master. Note that at the end of the arbitration, each agent knows the identity of the winner, as well as whether it has won or lost. The parallel contention arbiter thus described is a priority arbiter that is very fast but is also inherently unfair, since an agent with a higher identity will always win an arbitration against an agent with a lower identity, and thus higher priority agents will disproportionately control the bus.

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L5: Entry 109 of 135 File: USPT Dec 28, 1993

US-PAT-NO: 5274774
DOCUMENT-IDENTIFIER: US 5274774 A
** See image for Certificate of Correction **

TITLE: First-come first-serve arbitration protocol

DATE-ISSUED: December 28, 1993

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Manber; Udi	Tucson	AZ		
Vernon; Mary K.	Madison	WI		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Wisconsin Alumni Research Foundation	Madison	WI			02

APPL-NO: 07/ 879059 [PALM]
DATE FILED: April 30, 1992

PARENT-CASE:
CROSS-REFERENCE TO RELATED APPLICATIONS This application is a continuation of U.S. Ser. No. 07/304,701 filed Jan. 31, 1989, now abandoned.

INT-CL: [05] G06F 13/00, G06F 13/362

US-CL-ISSUED: 395/325; 364/242.7, 364/242.8, 364/230.1, 364/282.4
US-CL-CURRENT: 710/125

FIELD-OF-SEARCH: 395/650, 395/700, 395/325

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	3629854	December 1971	Hauck	395/325
☐	3761879	September 1973	Brandsma et al.	395/325
☐	3813651	May 1974	Yamada	395/325
☐	4099233	July 1978	Barbagelata et al.	395/250

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☐	4257095	March 1981	Nadir	395/325
☐	4263649	April 1981	Lapp, Jr.	395/325
☐	4321669	March 1982	Macmillan	395/325
☐	4363094	December 1982	Kaul et al.	395/325
☐	4374413	February 1983	Comfort et al.	395/725
☐	4374414	February 1983	Comfort et al.	395/725
☐	4375639	March 1983	Johnson, Jr.	395/325
☐	4385350	May 1983	Hansen et al.	395/325
☐	4418386	November 1983	Vrielink	395/325
☐	4419724	December 1983	Branigin et al.	395/325
☐	4463445	July 1984	Grimes	395/325
☐	4488217	December 1984	Binder et al.	395/375
☐	4600988	July 1986	Tendulkar et al.	395/325
☐	4682282	July 1987	Beasley	395/775
☐	4920486	April 1990	Nielsen	395/325

OTHER PUBLICATIONS

Gustavson, David B., "Computer Buses--A Tutorial," IEE Micro, Aug. 1984.
Vernon and Manber, "Distributed Round-Robin and First-Come First-Serve Protocols and Their Application to Multiprocessor Bus Arbitration," Computer Sciences Technical Report #745, Feb. 1988.

ART-UNIT: 236

PRIMARY-EXAMINER: Shaw; Gareth D.

ASSISTANT-EXAMINER: Chavis; John Q.

ATTY-AGENT-FIRM: Quarles & Brady

ABSTRACT:

A first-come first-serve arbitration protocol arbitrates between processing agents seeking access to a common bus. The system is an extension of a parallel contention arbiter in which each agent has an identity value made up of two portions, one a fixed portion and one a variable portion. The variable portion of each agent's identity is incremented depending on how long the agent has been waiting for access to the bus and the variable portion is the most significant portion of each agent's identity. Thus in each arbitration in which the highest identity value is awarded control of the bus, the agent which has waited the longest will gain access to the bus prior to those which have not waited as long.

5 Claims, 3 Drawing figures

First Hit Fwd Refs

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L5: Entry 109 of 135 File: USPT Dec 28, 1993

US-PAT-NO: 5274774
DOCUMENT-IDENTIFIER: US 5274774 A
** See image for Certificate of Correction **

TITLE: First-come first-serve arbitration protocol

DATE-ISSUED: December 28, 1993

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Manber; Udi	Tucson	AZ		
Vernon; Mary K.	Madison	WI		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Wisconsin Alumni Research Foundation	Madison	WI			02

APPL-NO: 07/ 879059 [PALM]
DATE FILED: April 30, 1992

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CROSS-REFERENCE TO RELATED APPLICATIONS This application is a continuation of U.S. Ser. No. 07/304,701 filed Jan. 31, 1989, now abandoned.

INT-CL: [05] G06F 13/00, G06F 13/362

US-CL-ISSUED: 395/325; 364/242.7, 364/242.8, 364/230.1, 364/282.4
US-CL-CURRENT: 710/125

FIELD-OF-SEARCH: 395/650, 395/700, 395/325

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	3629854	December 1971	Hauck	395/325
☐	3761879	September 1973	Brandsma et al.	395/325
☐	3813651	May 1974	Yamada	395/325
☐	4099233	July 1978	Barbagelata et al.	395/250

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☐	4257095	March 1981	Nadir	395/325
☐	4263649	April 1981	Lapp, Jr.	395/325
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☐	4363094	December 1982	Kaul et al.	395/325
☐	4374413	February 1983	Comfort et al.	395/725
☐	4374414	February 1983	Comfort et al.	395/725
☐	4375639	March 1983	Johnson, Jr.	395/325
☐	4385350	May 1983	Hansen et al.	395/325
☐	4418386	November 1983	Vrielink	395/325
☐	4419724	December 1983	Branigin et al.	395/325
☐	4463445	July 1984	Grimes	395/325
☐	4488217	December 1984	Binder et al.	395/375
☐	4600988	July 1986	Tendulkar et al.	395/325
☐	4682282	July 1987	Beasley	395/775
☐	4920486	April 1990	Nielsen	395/325

OTHER PUBLICATIONS

Gustavson, David B., "Computer Buses--A Tutorial," IEE Micro, Aug. 1984.
Vernon and Manber, "Distributed Round-Robin and First-Come First-Serve Protocols and Their Application to Multiprocessor Bus Arbitration," Computer Sciences Technical Report #745, Feb. 1988.

ART-UNIT: 236

PRIMARY-EXAMINER: Shaw; Gareth D.

ASSISTANT-EXAMINER: Chavis; John Q.

ATTY-AGENT-FIRM: Quarles & Brady

ABSTRACT:

A first-come first-serve arbitration protocol arbitrates between processing agents seeking access to a common bus. The system is an extension of a parallel contention arbiter in which each agent has an identity value made up of two portions, one a fixed portion and one a variable portion. The variable portion of each agent's identity is incremented depending on how long the agent has been waiting for access to the bus and the variable portion is the most significant portion of each agent's identity. Thus in each arbitration in which the highest identity value is awarded control of the bus, the agent which has waited the longest will gain access to the bus prior to those which have not waited as long.

5 Claims, 3 Drawing figures

L5: Entry 69 of 135 File: USPT Jul 18, 2000

DOCUMENT-IDENTIFIER: US 6092137 A
TITLE: Fair data bus arbitration system which assigns adjustable priority values to competing sources

Abstract Text (1):
A scheme for arbitrating access to a data bus shared among a plurality of competing sources is provided. Each competing source is assigned an adjustable priority weighting value (PWV) which is initially set to an initial value based on the bandwidth requirements of the competing source. During arbitration, the PWVs of those competing sources requesting access to the bus are compared, and the competing source with the smallest PWV is granted access. The PWV of the competing source which was granted access to the bus is reset to its initial value and the PWV of each competing source which requested, but was denied, access is reduced by one for subsequent comparisons. The arbitration scheme of the present invention is further applied to two-level arbitration. Each competing source is classified into a competing source group, and the requests from the grouped competing sources are processed by first level arbitration. First level arbitration passes one competing source for each group to a second level arbiter. The second level arbiter compares the PWVs of the competing sources resulting from first level arbitration to determine the competing source with the smallest PWV, and adjusts the PWVs after access to the bus has been granted.

Brief Summary Text (8):
Schemes such as round robin arbitration and first-come first-serve, although fair and relatively easy to implement, may result in unacceptable delays in granting access requests from these high priority sources. Accordingly, arbiters which favor efficiency over fairness often utilize a prioritization scheme in which sources are assigned relative priority values that are compared to determine which source gains access to the bus.

Brief Summary Text (18):
The present invention further provides a fair and efficient arbitration protocol which requires reduced circuit size to compare the priority values of the competing sources which have requested access to the shared data bus. This reduced circuit size is achieved by using a multi-level arbitration scheme. Initially, competing sources are classified into competing source groups based on their bandwidth requirements so that competing sources having the same, or similar, bandwidth requirements are assigned to the same group. Each competing source group is assigned to a first level arbiter which may utilize conventional arbitration schemes such as round robin arbitration or first-come first-serve. During the first level of arbitration, each first level arbiter selects one competing source and sends a selected request signal to a second level arbiter.

Detailed Description Text (10):
The two-level arbitration system illustrated in FIG. 6 operates as follows. Arbiter 20 assigns each competing source CS.sub.i an initial value of PWV in accordance with formula (1). Each competing source CS.sub.i is classified in a competing source group based on the initial value of PWV so that competing sources having the same, or similar, bandwidth requirements are classified in the same group. The adjustable PWVs are stored in PWV registers 48, 49, 52, 53, 56, and 57. Each

competing source sends access requests to a corresponding first level arbiter. For example, access requests from the competing sources in group #1 are sent to group #1 arbiter 42. The first level arbiters 42, 44, and 46 each select one competing source from their corresponding groups based on, for example, round robin arbitration. The results of the first level arbitration are sent to second level arbiter 20 through request lines 24, 25, and 26. Second level arbiter compares the PWVs of the competing sources selected by the first level arbiters 42, 44, and 46, and grants access to the competing source with the smallest PWV. This result is output on grant bus 29 and the PWV for each CS.sub.i which requested access to the data bus is adjusted through PWV update control line 28 in a manner previously discussed (i.e., the PWV of the winning competing source is reset to its initial value and the PWV of each competing source which was denied access is reduced by one). It can be seen from FIG. 6 that the number of comparisons performed by second level arbiter 20 to determine the smallest PWV is less than the number of prioritized competing sources which requested access to the bus because the first level arbiters 42, 44, and 46 output only one access request from a group of competing sources. This two level system thus reduces circuit size for priority value comparison.

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L5: Entry 69 of 135 File: USPT Jul 18, 2000

US-PAT-NO: 6092137
DOCUMENT-IDENTIFIER: US 6092137 A

TITLE: Fair data bus arbitration system which assigns adjustable priority values to competing sources

DATE-ISSUED: July 18, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Huang; Paul	Taipei			TW
Tseng; Huan-Pin	Hsin-Chu			TW
Wang; Yao-Tzung	Hsin-Chu			TW
Chang; Tai-Chung	Hsin-Chu			TW
Fan; Kuo-Yen	NanTou Hsien			TW

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Industrial Technology Research Institute	Hsinchu			TW	03

APPL-NO: 08/ 978580 [PALM]
DATE FILED: November 26, 1997

INT-CL: [07] G06 F 13/00

US-CL-ISSUED: 710/111; 710/107, 710/113, 710/40, 710/36, 710/42, 710/116, 710/123, 710/240, 710/241, 710/242, 710/244, 711/150
US-CL-CURRENT: 710/111; 710/107, 710/113, 710/116, 710/123, 710/240, 710/241, 710/242, 710/244, 710/36, 710/40, 710/42, 711/150

FIELD-OF-SEARCH: 710/111, 710/107, 710/113, 710/40, 710/36, 710/42, 710/116, 710/123, 710/240, 710/241, 710/242, 710/244, 711/150

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	4481583	November 1984	Mueller	710/107
☐	4672536	June 1987	Giroir et al.	710/107
☐	4901234	February 1990	Heath et al.	710/107

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☐	5088024	February 1992	Vernon et al.	
☐	5168568	December 1992	Thayer et al.	710/125
☐	5261109	November 1993	Cadambi et al.	
☐	5265223	November 1993	Brockmann et al.	
☐	5276899	January 1994	Neches	709/240
☐	5349690	September 1994	Frame et al.	
☐	5392033	February 1995	Oman et al.	
☐	5430848	July 1995	Waggener	710/107
☐	5450591	September 1995	Palmer	710/113
☐	5485586	January 1996	Brash et al.	
☐	5509125	April 1996	Johnson et al.	
☐	5519837	May 1996	Tran	
☐	5560016	September 1996	Fiebrich et al.	710/240
☐	5581782	December 1996	Sarangdhar et al.	
☐	5590299	December 1996	Bennett	
☐	5809278	September 1998	Watanabe	711/150
☐	5881313	March 1999	Ramakrishnan et al.	710/40

ART-UNIT: 271

PRIMARY-EXAMINER: Sheikh; Ayaz R.

ASSISTANT-EXAMINER: Jean; Frantz Blanchard

ABSTRACT:

A scheme for arbitrating access to a data bus shared among a plurality of competing sources is provided. Each competing source is assigned an adjustable priority weighting value (PWV) which is initially set to an initial value based on the bandwidth requirements of the competing source. During arbitration, the PWVs of those competing sources requesting access to the bus are compared, and the competing source with the smallest PWV is granted access. The PWV of the competing source which was granted access to the bus is reset to its initial value and the PWV of each competing source which requested, but was denied, access is reduced by one for subsequent comparisons. The arbitration scheme of the present invention is further applied to two-level arbitration. Each competing source is classified into a competing source group, and the requests from the grouped competing sources are processed by first level arbitration. First level arbitration passes one competing source for each group to a second level arbiter. The second level arbiter compares the PWVs of the competing sources resulting from first level arbitration to determine the competing source with the smallest PWV, and adjusts the PWVs after access to the bus has been granted.

16 Claims, 8 Drawing figures

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1 **An assertional proof of a lock synchronization algorithm using fetch store atomic instructions**
Ting-Lu Huang; Jann-Hann Lin;
Parallel and Distributed Systems, 1994. International Conference on , 19-21 I 1994
Pages:759 - 768

[Abstract] [PDF Full-Text (832 KB)] **IEEE CNF**

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2 **Efficient distributed disk caching in data grid management**
Song Jiang; Xiaodong Zhang;
Cluster Computing, 2003. Proceedings. 2003 IEEE International Conference o 4 Dec. 2003
Pages:446 - 451

[Abstract] [PDF Full-Text (627 KB)] **IEEE CNF**

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3 **Priority arbiters**
Bystrov, A.; Kinniment, D.J.; Yakovlev, A.;
Advanced Research in Asynchronous Circuits and Systems, 2000. (ASYNC 20(Proceedings. Sixth International Symposium on , 2-6 April 2000
Pages:128 - 137

[Abstract] [PDF Full-Text (188 KB)] **IEEE CNF**

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